RESEARCH, DEVELOPMENT & TECHNOLOGY TRANSFER
QUARTERLY PROGRESS REPORT

Wisconsin Department of Transportation
DT1241 02/2011

INSTRUCTIONS:
Research project investigators and/or project managers should complete a quarterly progress report (QPR) for each calendar quarter during which the projects are active.

WisDOT research program category: ☐ Policy research ☒ Wisconsin Highway Research Program ☐ Other ☐ Pooled fund TPF#		Report period year: 2014 ☒ Quarter 1 (Jan 1 – Mar 31) ☐ Quarter 2 (Apr 1 – Jun 30) ☐ Quarter 3 (Jul 1 – Sep 30) ☐ Quarter 4 (Oct 1 – Dec 31)
Project title: Critical Factors Affecting Asphalt Concrete Durability		
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WisDOT project ID: 0092-14-06	Other project ID:	Project start date: 9/18/2013
Original end date: 3/17/2015	Current end date: 3/17/2015	Number of extensions: 0

Project schedule status:
☒ On schedule ☐ On revised schedule ☐ Ahead of schedule ☐ Behind schedule

Project budget status:

Total Project Budget	Expenditures Current Quarter	Total Expenditures	% Funds Expended	% Work Completed
$175,000.00	$6,290.83	$9,964.68	5%	5%

Project description:

The objective of this project is to develop recommended revisions to WisDOT specifications and guidance documents to improve the durability of asphalt concrete mixtures. The project will focus on changes to the composition of asphalt mixtures that WisDOT should consider to improve durability. The recommendations will be based on promising findings from completed research addressing asphalt concrete durability and the results of a laboratory study formulated specifically to evaluate the effectiveness of these promising findings for Wisconsin materials and environmental conditions. The project includes six tasks:

1. **Synthesis of Current Research.** Research on the durability of asphalt mixtures completed since NCHRP Projects 9-25 and 9-31 will be reviewed to identify recommendations for improving mixture durability.
2. **Work Plan Development.** Appropriate laboratory experiments will be designed based on the findings of Task 1.
3. **Interim Presentation and Project Memorandum.** The findings of Task 1 and the work plan developled in Task 2 will be presented to the Technical Oversight Committee (TOC).
4. **Execution of Work Plan and Analysis of Results.** The experiments in the work plan approved by the TOC will conducted and the results analyzed.
5. **Project Deliverables.** A report documenting the project and making recommendations concering changes to WisDOT specifications to improve durability will be prepared.
6. **Final Report and Project Closeout Activities.** The report and recommendations will be presented to the TOC and the report will be revised based on comments from the TOC.

Progress this quarter (includes meetings, work plan status, contract status, significant progress, etc.):

Task 1. Synthesis of Current Research. This task was completed this Quarter. Relevant information from the 2014 Annual Meeting of the Transportation Research Board, and the 2014 Annual Meeting of the Association of Asphalt Paving Technologists was included in the synthesis. The synthesis includes sections on:

1. Definition of Durability
2. Factors Affecting Asphalt Mixture Durability
3. Methods to Improve Asphalt Mixture Durability
4. Relevant Models for Assessing Mixture Properties
5. Test Methods to Assess Durability

Task 2. Work Plan Development. This task was completed this Quarter. A telephone conference with the Principal Investigator ans the TOC was held on February 6, 2014 to discuss the work plan. Based on the Task 1 findings and input from the TOC, the work plan was developed to address the following mixture design factors at two levels of aging:

1. Binder volume
2. Amount of recycled binder
3. Binder modification
4. Binder low temperature grade

The test that will be used to evaluate these factors is the Semi-Circular Bend Test at intermediate temperatures as developed at the Louisiana Transprot Research Center (LTRC). This test was selected for the following reasons:

1. The critical energy release rate from the test has been correlated with cracking at intermediate temepratures.
2. A measure of stiffness to evaluate age hardening can be obtained from the load displacement curve.
3. Of the available fracture tests, fabrication and testing procedures appear to be appropriate for mix design and acceptance.

To simulat different levels of aging, mixtures will be tested after short- and long-term conditioning in accordance with AASHTO R30. Extended long term compacted mix conditioning or loose mix conditioning will be considered depending on the results of research currently being conducted in NCHRP Project 9-54, Long-Term Aging of Asphalt Mixtures for Performance Testing and Prediction.

To evaluate the relative effects of each of the mixture design factors and their interaction, the experimental design that was developed is based on response surface modeling which is often used for optimizing processes with non-linear effects. The recommended design is a Box-Behnken design and requires 27 combinations to evauate four factors at three levels. A complete factorial wihtout replication requires testing 81 combinations. The factors and their levels are summarized in Table 1. Regression analysis will be used to develop response surfaces for short-conditioned and long-term conditioned samples. These response surfaces will then be used to quantify the relative effects of each of the factors on stiffness and resistance to cracking. Based on available funds, the experiment can be repeated for two different aggregates. Selection of the specific aggregates, binders, and mixtures will be discussed with the TOC at the meeting planned for Task 3.

Table 1. Proposed Factor Levels.

Factor	Levels		
	Low	Medium	High
Binder Volume	Design -1	Design	Design +1
Recycle Content	None	RAP	RAP +RAS
Modification	PG 58 S	PG 58 H	PG 58 V
Low temperature Grade	PG XX-22	PG XX-28	PG XX-34

Task 3. Interim Presentation and Project Memorandum. Tasks 1 and 2 are being documented in an Interim Report that will serve as the Project Memorandum. It is anticipated that this report will be submitted to WHRP in April. A meeting of the TOC will be scheduled to review the report and select specific materials for the experiment.

Task 4. Execution of Work Plan and Analysis of Results. No work has been performed on this task.

Task 5. Project Deliverables. The Interim Report for Tasks 1 and 2 will be included in the final report for the project. No additional work on project deliverables was completed.

Task 6. Final Report and Project Closeout Activities. No work has been performed on this task.

Anticipated work next quarter:

Task 1. Synthesis of Current Research. This task has been completed.

Task 2. Work Plan Development. This task has been completed.

Task 3. Interim Presentation and Project Memorandum. This task will be completed next quarter.

Task 4. Execution of Work Plan and Analysis of Results. Sampling of materials for the laboratory testing will be completed next quarter after the meeting with the TOC.

Task 5. Project Deliverables. Documentation of the final experimental design and the materials for the laboratory testing will be completed.

Task 6. Final Report and Project Closeout Activities. No work is planned for this task.

Circumstances affecting project or budget:

The project is behind schedule. The original scehdule include in the proposal was based on an anticipate start date of August 1 and the schedule was developed to complete material sampling before winter. The project started about 1.5 months later, and rather than shortening Tasks 1 and 2 to complete sampling before winter, the Principal Investigator decided to extend these tasks and complete field sampling in the spring. This change should not affect the completion date of the project.

Attach / insert Gantt chart and other project documentation

Task/Activity	2013							2014							2015						
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Task 1. Synthesis of Current Research.	P	P	P																		
	A	A	A	A	A	A															
Task 2. Work Plan Development.		P	P																		
			A	A	A	A															
Task 3. Interim Presentation and Project Memorandum.				P																	
				A	A	A															
Task 4. Execution of Work Plan and Analysis of Results.					P	P	P	P	P	P	P	P	P	P	P	P					
Task 5. Project Deliverables.															P	P	P	P			
Task 6. Final Report and Project Closeout Activities.																			P	P	P
Presentations				P																	
Quarterly Reports				P			P			P			P			P			P		
Project Memorandum				P																	
Draft Final Report																					
																			P		
Revised Final Report																					
																					P

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Staff receiving QPR:	Date received:
Staff approving QPR:	Date approved: